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Compiled by
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Lockheed

MISSILES & SPACE COMPANY

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SUNNYVALE, CALIFORNIA

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ABSTRACT

Since this work treats of a complex of space environmental parameters having in common the inclusion of aerodynamic heating as one of those parameters, material dealing with aerodynamic heating as an isolated phenomenon has not been included. The abstracts are arranged alphabetically by author. Corporate author, personal author, and subject indexes are included. The period covered, with one earlier exception, is from 1959 through 1962. The resources of the Technical Information Center, Lockheed Missiles & Space Company, were utilized.

Search Completed February 1963.

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1. Adams, Mac C.
A LOOK AT THE HEAT TRANSFER PROBLEM AT SUPER SATELLITE SPEEDS. AVCO Research Lab., Everett, Mass. Rept. no. AMP 53. Dec 1960. 24p. (Contract AF 04(647)278) ASTIA AD-250 313.

An investigation of stagnation point heating for the speed range between 25,000 and 45,000 ft/sec. Convective heat transfer is treated approximately, allowing for the influence of electronic heat conduction associated with these high speeds. It is shown that electronic effects lead to no more than a 30% increase in the net convective heating. Radiation is compared with convective heating; it is pointed out that radiation is strongly influenced by the re-entry trajectory, the radiation becoming increasingly important the lower the altitude of slow-down. The importance of non-equilibrium radiation occurring at high altitude is also discussed.

2. Aeronautical Systems Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio.
PROCEEDINGS OF SYMPOSIUM ON AERO-THERMOELASTICITY, 30–31 OCTOBER AND 1 NOVEMBER 1961. 1961. 1023p. ASD technical rept. no. 61-645. ASTIA AD-271 529.

Proceedings of a symposium on aerothermoelasticity, held to present the latest significant developments in each scientific and engineering area of this technoiogy. New and significant contributions were presented in four technical areas consisting of dynamic aerothermoelasticity (flutter), stability and control, thermodynamics and aerodynamics (or aerothermodynamics), and structures including material and construction concepts. Categories significant in each technical area were discussed and given on items of special importance.

3. Anderson, Melvin S., and C. W. Stroud
EXPERIMENTAL OBSERVATIONS OF AERO-DYNAMIC AND HEATING TESTS ON INSULATING HEAT SHIELDS. National Aeronautics and Space Administration, Washington, D. C. Mar 1962. 19p. Technical note D-1237. ASTIA AD-273 316. (Also available from NASA, Wash. 25, D. C., as NASA Technical note D-1237.)

Several types of insulating heat shields were subjected to aerodynamic and radiant-heating tests for a better insight into the problems involved when the primary structure of an aerodynamically heated vehicle is substantially cooler than the exposed external surface. A proper allowance for thermal expansion caused by these large temperature differences, so that undue distortion or thermal stresses would not occur in either the outer shield or the underlying structure, was a major problem. A corrugated outer skin with suitably designed expansion joints was a feature of the specimens tested.

4. Anderson, Roger A. and William A. Brooks, Jr.
Effectiveness of radiation as a structural cooling technique for hypersonic vehicles. JOURNAL OF THE AEROSPACE SCIENCES 27:41-48, 1960.

An examination of the effectiveness of radiation as a structural cooling technique for vehicles subject to large variations in surface heating. The more significant effects of internal heat transfer within idealized structures (both with and without external insulation on areas of the greatest aerodynamic heating intensity) are analyzed. It is concluded that the selective use of insulation leads to structural temperature reductions materially greater than those that can be obtained without insulation.

5. Applied Physics Labs., Johns Hopkins U., C
Silver Spring, Md.
QUARTERLY REVIEW OF APL ACTIVITIES JULY–SEPTEMBER 1961. II. SPACE EXPLORATION AND RESEARCH AND DEVELOPMENT (U). 1961. 90p. incl. illus. tables. Bumblebee rept. no. 308B (Contract NOrd-7386) ASTIA AD-327 457.
CONFIDENTIAL REPORT

6. Ardouin, Pierre G. and Louis P. A. Robichaud
AN ALWAC III-E PROGRAM FOR COMPUTING RE-ENTRY TRAJECTORIES HAVING SIX DEGREES OF FREEDOM. Canadian Armament Research and Development Establishment. Dec 1961. 30p. CARDE Technical memo no. 665/62. ASTIA AD-273 428.

Describes a digital computer program for solving the complete equations of the trajectory of a re-entry vehicle. The effect of spin rate and trim angle on the trajectory of re-entry bodies is studied as part of lethality study in support of terminal defense against ballistic missiles. The general analysis can be applied to undamaged or damaged vehicles with appropriate changes in the aerodynamic parameters.

7. Ardouin, Pierre G.
NUMERICAL SOLUTION FOR ONE-DIMENSIONAL HEAT CONDUCTION IN THE SKIN OF A RE-ENTRY VEHICLE. Canadian Armament Research and Development Establishment. Feb 1962. 37p. CARDE Technical memo. no. 666/62. ASTIA AD-274 232

Support of CARDE's study of terminal defence against ballistic missiles necessitated an investigation of the effect of aerodynamic heating on re-entry vehicles. This report

presents a method for calculating the heat conduction from the outer surface to the inner surface of the heat shields of such vehicles as they re-enter through the earth's atmosphere.

8. AVCO Everett Research Lab., Everett, Mass.
STUDY OF A DRAG BRAKE SATELLITE
RECOVERY SYSTEM, VOLUME III. Jan 1962.
363p. ASD TR 61-348, Vol. 3. (Contract
AF 33(600)41291) ASTIA AD-274 088

Contents: Aerospace dynamics (Aerodynamics, aeroelasticity, and upper atmosphere physics); Ground support (Mechanical and electrical maintenance ground equipment, electrical test support equipment, and balloon and orbital test programs); and System tests (Laboratory test and quality assurance program, wind tunnel tests, flight test program, operational support, and hot tests).

9. Batt, R. G. C
MINUTEMAN – INFLUENCE OF TRAJECTORY
UPON STRUCTURAL TEMPERATURES (U).
Space Technology Labs., Inc., Redondo Beach,
Calif. Mar 1962. 29p. Rept. no. 6120-7623-
NC-000. ASTIA AD-330 180. CONFIDENTIAL
REPORT.

10. Becker, J., et al. C
ULTRA-LOW-PRESSURE ROCKET (ULPR)
PROPULSION SYSTEM. VOLUME I (U).
Martin Co., Denver, Colo. Final technical
summary rept. on Phase I. Rept. no.
FTC-CR-61-2, vol. 1. (Contract AF
04(611)7434) CONFIDENTIAL REPORT.

11. Becker, J., et al. C
ULTRA-LOW PRESSURE ROCKET (ULPR) PROPULSION SYSTEM, VOLUME II. APPENDIX (U). Martin Co., Denver, Colo. Final technical summary rept. on Phase I. Feb 1962. 1v. (Rept. no. FTC-CR-61-2, vol. 2) (Contract AF 04(611)7434) ASTIA AD-327 829. CONFIDENTIAL REPORT.

12. Brainerd, Jerome J.
VARIATIONAL PROCEDURE FOR MINIMIZING HEATING EFFECTS DURING THE RE-ENTRY OF A LIFTING VEHICLE. VOLUME II – HEAT TRANSFER TO SLENDER HYPERSONIC DELTA WINGS NEAR 90 DEGREES INCIDENCE. General Dynamics/Convair, San Diego, Calif. Final rept., volume 2 for 15 June 1960 – 14 June 1961 on Flight Path Analysis. Apr 1962. 37p. (WADD TR 60-369, vol. 2) (Contract AF 33(616)6380, Proj. 1431) ASTIA AD-277 162.

Pressure distribution and heat transfer were calculated for hypersonic delta wings of very low aspect ratio at angles of attack near 90 degrees. Calculations were based on the assumption that the flow field can be approximated by considering the wing as composed of a series of independent spanwise strips over which the flow is two-dimensional. For these two-dimensional strips, the shock wave was assumed to be nearly normal to the free stream, and the inviscid shock layer calculated by using Newtonian theory. The heat transfer to the wing was calculated with the inviscid Newtonian results as conditions at the edge of the boundary layer. Results are given in terms of the shock density ratio and angle of attack for flight and perfect gas cases. Comparison of these results with experimental data shows good agreement for angles of attack above about 70 degrees.

13. Brooks, William A., Jr., et al. C
AN EVALUATION OF THERMAL PROTECTION FOR APOLLO (U). National Aeronautics and Space Administration, Washington, D. C. Dec 1961. 16p. NASA Technical memo no. X-613. (Presented at the NASA-Industry Apollo Technical Conference, Wash., D. C., July 18–20, 1961.) (Also available from NASA, Wash. 25, D. C. as NASA Technical memo. X-613.) ASTIA AD-326 915.
CONFIDENTIAL REPORT

14. Brunelle, Eugene J., Jr.
TRANSIENT AND NONLINEAR EFFECTS ON HIGH SPEED, VIBRATORY, THERMOELASTIC INSTABILITY PHENOMENA. Aeroelastic and Structures Research Lab., Mass. Inst. of Tech., Cambridge. Rept. for 15 Jan 1959–May 1960 on Dynamic Problems in Flight Vehicles. Dec 1960. 117p. WADD TR 60-484, pt. 2 (Contract AF 33(616)6185, Proj. 1370) ASTIA AD-266 375.

Research on the formulation and investigation of the equations representing the dynamic, torsion-bending motion of a wing which is one major component of an ultra-high performance manned vehicle. Preliminary work, an integral part of the report, includes (1) the derivation of an exact two-dimensional linearized aerodynamic theory for an accelerating unsteady supersonic airfoil, (2) the re-derivation of piston theory aerodynamics for arbitrary motion, and (3) a derivation for the torsional stiffness loss of an aircraft wing that includes the effects of a specified time-dependent wall temperature due to the given flight mission and that includes the effects of mid-plane stretching. The computer studies consider a super X-15 type wing performing two specified flight missions and provide answers in the form of pitch and plunge impulse response time histories. The exact solutions are compared with two approximate solutions. Results indicate that a quasi-steady aero-thermoelastic analysis is adequate for manned vehicles of the foreseeable future.

15. Brunner, M. J.
THE AERODYNAMIC AND RADIANT HEAT INPUT TO SPACE VEHICLES WHICH RE-ENTER AT SATELLITE AND ESCAPE VELOCITY. Space Sciences Lab., General Electric Co., Philadelphia, Pa. 1960. 24p. ARS rept. no. 1558-60. (Contract AF 04(647)269) (Presented at the ARS 15th Annual Meeting, Washington, D.C., December 5–8, 1960.) ASTIA AD-255 049.

An analysis of the aerodynamic and radiant heat input for space vehicles re-entering at satellite and escape velocity. The magnitude of the heat flux and total heating for convection (laminar and turbulent flow) and radiation from the gas cap are given as a function of W/(CD)(A) (where W is weight, CD is drag coefficient, and A is area), re-entry angle, lift over drag ratio and local pressure distribution. Consideration is also given to re-entry at escape velocity with one skip at satellite velocity as a means for reducing the magnitude of the deceleration and heat flux.

16. Bureau of Naval Weapons, Navy Dept., Washington D.C.
PROCEEDINGS OF THE FIFTH U. S. NAVY SYMPOSIUM ON AEROBALLISTICS, VOLUME I. SPONSORED BY THE BUREAU OF NAVAL WEAPONS ADVISORY COMMITTEE ON AERO-BALLISTICS, AT THE U.S. NAVAL ORDNANCE LABORATORY, WHITE OAK, SILVER SPRING, MARYLAND, 16–18 OCTOBER 1961. Oct 1961. ASTIA AD-269 885.

17. Coplan, Myron J. and W. Denney Freeston, Jr.
HIGH SPEED FLOW AND AERODYNAMIC
HEATING BEHAVIOR OF POROUS FIBROUS
STRUCTURES. Fabric Research Labs., Inc.,
Boston, Mass. Rept. for March 1960–July 1961
on Fibrous Materials for Decelerators and
Structures. Oct 1961. 93p. WADD TN 61-58.
(Contract AF 33(616)7222, Proj. 7320)
ASTIA AD-271 960.

A detailed examination of possible flow patterns over and heat transfer to a porous fibrous structure in a re-entry environment. The expressions for a theoretical estimate of the heat transfer increase to the structure are developed. Unqualified statements of the precise heat transfer increase as a function of structure porosity are not possible in light of the obvious need for experimental verification. However, the investigation indicates that a moderate porosity can be tolerated without a significant temperature increase under some flight conditions.

18. Davis, G. J., et al.
RESEARCH ON TEMPERATURE ATTITUDE
SENSING TECHNIQUES FOR RE-ENTRY
VEHICLES PHASE I. Research and Advanced
Development Div., AVCO Corp., Wilmington,
Mass. Rept. for Jan–Sep 1961. Feb 1962.
150p. ASD TR 61-539. (Contract AF 33(616)7816,
Proj. 8222) ASTIA AD-275 375.

An analytical examination of the intensity and distribution of convective heat flux to a re-entering vehicle was made from the point of view of developing useful flight intelligence. It was demonstrated that maximum economy of instrumentation is obtained when a hemispherical nose cap is utilized as a heat flux probe. The basic instrumentation is a symmetric network (about the hemispherical nose cap) of thermal sensors. The dynamics of such sensors were mathematically explored, and electrical analogs of the pertinent mathematics developed. Analog circuitry was presented which converts the electrical outputs of the temperature sensors to electrical records of (1) stagnation point heat flux, and (2) angles of attack and sideslip. Applications of this information to the areas of control, environment metering, and thermal warning were discussed. The likely quality (sensitivity, accuracy) of the intelligence was examined. The results indicated that application to vehicle control appears feasible for high lift vehicles. More limited functions could be served by a thermal attitude sensing system on other types of vehicles.

19. Dershin, Harvey and Kenneth J. Schneider
Heat transfer and flow characteristics over a lenticular aerodynamic body. ARS. JOURNAL 32:1269–1272, 1962.

A discussion of the experimental heat transfer and pressure distributions obtained (at a Mach number of 3.97) for the forward area of a low drag lenticular aerodynamic body at zero angle of attack. It is demonstrated that (1) experimental results are predictable within engineering accuracy with the aid of a simple strip analysis, and (2) an interesting similarity for the heat transfer coefficients and static pressures could be observed in the region under investigation.

20. Engholm, G., R.J. Baschiere, and R.A. Bambenek
INSTANTANEOUS LOCAL TEMPERATURES OF AERODYNAMIC DECELERATORS. PART I. METHODS OF PREDICTING. American Machine and Foundry Co., Niles, Ill. Rept. for July 1959–Aug 1960 on Fibrous Materials for Decelerators and Structures. Dec 1960. 74p. WADD TR 60-670, pt. 1. (Contract AF 33(616)6673, Proj. 7320) ASTIA AD-267 062.

Presentation of a numerical technique for predicting temperatures developed in aerodynamic decelerators at high speeds. The predictions are obtained (1) by a simple method to estimate local equilibrium temperatures and (2) by a more complex method to estimate instantaneous, local, temperature profiles. Sample calculations are included. A new numerical technique for predicting one dimensional thermal diffusion permits the use of larger time increments and therefore fewer calculations are necessary than with other numerical techniques.

21. Etkin, B.
THE ENTRY OF MANNED MANOEUVREABLE SPACECRAFT INTO PLANETARY ATMOSPHERES.
Institute of Aerophysics, U. of Toronto (Canada).
Oct 1961. 33p. UTIA review no. 20. (AFOSR-1963)
(A written version of a lecture given by the author at the Symposium on Interplanetary Explorations, Institute of Aerosphysics, University of Toronto, Oct 26–27, 1961)
ASTIA AD-273 699.

A discussion of three main problem areas for the landing of space vehicles. The first concerns the deceleration to which the vehicle and its occupants are subjected. The second concerns the heating of the vehicle, i.e., the temperatures developed in the skin and structure. The third concerns the navigation or guidance of the vehicle to a desired point on the surface.

22. Etkin, B.
ON A RELATIVELY COOL TRANSITION FROM A SATELLITE ORBIT TO AN EQUILIBRIUM GLIDE. Institute of Aerophysics, U. of Toronto (Canada). Jun 1961. 52p. UTIA rept. no. 75. (AFOSR-1383) (Contract AF 49(638)761)
ASTIA AD-265 550.

Presentation of one family of solutions for a monotonic transition from a circular orbit to an equilibrium glide. It is performed at high lift coefficient and low L/D, and terminates at a match point where the prescribed conditions of the glide are met. The vehicle then continues on the glide at a higher value of L/D. The high drag required during transition entails the use of a large auxiliary light-weight drag body, which is jettisoned upon arrival at the match point. The presence of this drag body results in a reduction of the total heat load on the vehicle itself. The exact amount of this reduction depends on the details of the design, but it can be typically of the order of 3/4 in an entry with a peak acceleration of the order of 7 g. As a result, the maximum average vehicle temperature can be made relatively low, with consequent advantages in the structural design and in the thermal protection of the payload.

23. Faget, Maxime A., Benjamine J. Garland, and James J. Buglia
PRELIMINARY STUDIES OF MANNED SATELLITES WINGLESS CONFIGURATION: NONLIFTING.
National Aeronautics and Space Administration, Washington, D. C. Technical note D-1254; Supersedes NACA Research memo. L58E07a, dtd 11 Aug 1958. AD-222 350. Mar 1962. 16p. (Also available from NASA, Wash. 25, D.C., as NASA Technical note D-1254.) ASTIA AD-273 087.

Consideration of a simple nonlifting satellite vehicle which follows a ballistic path in re-entering the atmosphere. The research and production experiences of the ballistic-missile programs are applicable to its design and construction, and since it follows a ballistic path, there is a minimum requirement for autopilot, guidance, or control equipment. After comparing the loads that would be attained with man's allowable loads, and after examining the heating and dynamic problems of several specific shapes, it appears that, insofar as reentry and recovery are concerned, the state of the art is sufficiently advanced so that it is possible to proceed confidently with a manned-satellite project based upon the ballistic-reentry type of vehicle.

24. Fay, James A.
HYPERSONIC HEAT TRANSFER IN THE AIR LAMINAR BOUNDARY LAYER. AVCO Everett Research Lab., Mass. Rept. no. AMP 71. Mar 1962. 39p. (Presented at Advisory Group for Aeronautical Research and Development Hypersonics Specialists' Conference, Brussells, Belgium April 3-6, 1962.) ASTIA AD-283 503.

A review of the methods and data used in computing the transport properties in a laminar boundary layer in air on a vehicle moving at velocities as great as 50,000 fps. Particular attention is given to the problem of determining the transport properties of partially ionized air. Comparisons are made of the transport properties which have been estimated by various authors as well as the heat transfer determined from the solution of the laminar boundary layer equations for stagnation point flow. The latter are compared with some experimental measurements.

25. Flickinger, H. S. S
TITAN RE-ENTRY VEHICLE FLIGHT EVALUATION REPORT. AVCO RAD MARK 4, MOD 1A-4 FLIGHT OF 27 MAY 1960 AFMTC FLIGHT TEST NO. 1504. MISSILE NO. G-9 (U). Research and Advanced Development Div., AVCO Corp., Wilmington, Mass. Rept. on Weapon System 107A-2. 17 Aug 1960. 82p. Rept. no. RAD-SR-9-60-68. (Contract AF 04(647)305) ASTIA AD-326 747. SECRET REPORT

26. Georgiev, S., J.D. Teare and R.A. Allen
HYPERVELOCITY RADIATIVE HEAT TRANSFER. AVCO Everett Research Lab., Mass. Research note no. 264. Aug 1961. 28p. (Presented at 1961 Air Force/Aerospace Corporation Symposium on Ballistic Missile and Aerospace Technology. Univ. of Southern California. Los Angeles. California. August 28–30. 1961.) (AFBSD TN 61-33; AFCRL 62–39) (Contracts AF 04(647)278 and AF 19(604)7458) ASTIA AD-275 130.

A discussion of the radiative heating encountered by vehicles re-entering at super-satellite velocities. Both equilibrium and non-equilibrium radiation were considered, and the state of the theoretical and experimental knowledge of both these phenomena discussed. For super-satellite re-entry velocities the radiative heating could be a significant or a dominating portion of the stagnation point heating. The effects of trajectory and vehicle parameters on the radiative heating were also discussed; radiative heating could be minimized by using a small nose radius or by decelerating at high altitudes. The effect of radiative heating on the performance of ablating materials was discussed.

27. Goulard, Robert and Madeleine
THE AEROTHERMODYNAMICS OF REENTRY TRAILS. Bendix Systems Div., Bendix Corp., Ann Arbor, Mich. Research note no 7. 6 May 1960. 17p. (Contract DA 11-022-ORD-3130) ASTIA AD-268 804.

The physico chemical phenomena that can be observed in the near flow field and in the wake of re-entry bodies are governed mostly by the energy distribution in this field. This, in turn, is governea by heat losses and chemical relaxation in the atomic recombination process. A criterion is developed to test the stability of chemical equilibrium around the body and help determine the initial conditions in the wake diffusion problem. The effect of the nose design past the sonic line is quite important. A numerical method is used to solve the equilibrium laminar wake problem and a simplified closed model is proposed. The effect of the atmospheric gradient on the wake behavior is analysed.

28. Graziano, Eugene E.
SELECTED OXIDATION-RESISTANT REFRACTORY COATINGS FOR METALS TESTED AT 3000 DEGREES-6000 DEGREES F. AN ANNOTATED BIBLIOGRAPHY. Lockheed Aircraft Corp., Sunnyvale, Calif. Special bibliography no. SB-61-53; Rept. no. 6-90-61-9. Oct 1961. 26p. ASTIA AD-271 940.

Literature references are presented on the possible applications of ceramic coatings to problems of re-entry. Test results of oxide and boride ceramic refractory coatings on metals, at temperatures greater than 3000 F for periods up to one hour are included. Of particular interest were test results regarding oxidation, thermal protection, thermal shock, impact effects, and mechanical data. A very complete search was made from 1959 to date, but the selection of references was sometimes arbitrary, and depended upon technical or other interests of specific researchers.

29. Guttman, A. S
A COMPARISON OF IR-OPTICAL RE-ENTRY RADIATION OF A MARK 4 AND A TVX NOSE CONE (U). Space Sciences Lab., General Electric Co., Philadelphia, Pa. Rept. no. DIN: R62SD1 -B. Feb 1962. 21p. (Contract AF 04(694)13) ASTIA AD-328 992. SECRET REPORT

30. Guttman, A., E. Branyan, and M. Lotman S
TERMINAL RADIATION PROGRAM ASCENSION ISLAND C-54 OPERATION (U). Space Sciences Lab., General Electric Co., Philadelphia, Pa. Preliminary rept. on Re-entry Radiation Measurements of AMR Test No. 4502. Rept no. TRAP-08P. Jan 1962. 27p. (Contract AF 04(694)13) ASTIA AD-327 919. SECRET REPORT

31. Guttman, A. S
(UNVERIFIED TITLE) Space Sciences Lab., General Electric Co., Philadelphia, Pa. 3 Nov 1961. 26p. (Contract AF 04(694)13) ASTIA AD-327 658. SECRET REPORT

32. Harris, Robert S., Jr., and John R. Davidson
METHODS FOR DETERMINING THE OPTIMUM DESIGN OF STRUCTURES PROTECTED FROM AERODYNAMIC HEATING AND APPLICATION TO TYPICAL BOOST-GLIDE OR REENTRY FLIGHT PATHS. National Aeronautics and Space Administration, Washington, D. C. Technical note D-990. Mar 1962. 37p. (Also available from NASA, Wash. 25, D. C., as NASA Technical note D-990.) ASTIA AD-273 255.

General equations are developed for the design of efficient structures protected from thermal environments typical of those encountered in boost-glide or atmospheric-reentry conditions. The method is applied to insulated heat-sink stressed-skin structures and to internally cooled insulated structures. Plates loaded in compression are treated in detail. Under limited conditions of plate buckling, high loading, and short flight periods, and for aluminum structures only, the weights of both configurations are nearly equal. Load parameters are found and are similar to those derived in previous investigations for the restricted case of a constant equilibrium temperature at the outside surface of the insulation.

33. Hayman, Lovick O., Jr. and Russell W. McDearmon
JET EFFECTS ON CYLINDRICAL AFTERBODIES HOUSING SONIC AND SUPERSONIC NOZZLES WHICH EXHAUST AGAINST A SUPERSONIC STREAM AT ANGLES OF ATTACK FROM 90 DEGREES TO 180 DEGREES. National Aeronautics and Space Administration, Washington, D. C. NASA Technical note D-1016. Mar 1962. 49p. (Also available from NASA, Wash. 25, D. C) ASTIA AD-273 312.

Tests were conducted at a free-stream Mach number of 2.91 and at free-stream Reynolds numbers, based on body diameter, of 0.15 and 0.30 times 10 to the 6th power. The range of the ratio of jet total pressure to free-stream static pressure investigated was from jet off to about 400. The data showed that, in general, variation of the ratio of jet total pressure to free-stream static pressure, jet-exit Mach number, and ratio of jet-exit diameter to body diameter had large influences on the body pressures on the windward halves of the afterbodies and negligible influences on the leeward pressures. There was a negligible effect of Reynolds number on the body pressures. The ratio of jet total pressure to free-stream static pressure also had a large influence on the base pressures at all angles of attack. Schlieren studies showed details of the shock-wave structure caused by the jet and the extent of the jet interference flow fields.

34. Hill, M. L. and J. M. Akridge
EVALUATION OF SHINGLE INSULATION FOR HIGH TEMPERATURE APPLICATIONS. Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Rept. for 15 Dec 1960 – 30 Sep 1961. Rept. no. TG-428-2. 15 Dec 1961. 11p. (WAL TR 786.2/1-1) (Contract NOrd-7386) ASTIA AD-278 060

Investigation continued on a thermal insulation which has possible applications in protecting structural components, including rocket nozzles, from aerodynamic and combustor heating. The insulation, made up of thin overlapping strips of refractory materials bonded to the structure at an acute angle, is referred to as shingles. Thermal conductivity measurements of several stainless steel panels with variations in stagger angle and spacing of shingles are reported. Results of structural tests in aerodynamic environment including simulated conditions of Mach 1.6 at sea level and Mach 5 at 95,000 ft are reported. Several designs of shingles survived these conditions and withstood more severe tests in which artificially generated shock waves impinged on the insulated surface.

35. Johnson, C. H., William H. Smith, and J. R. Katz
NOTES ON ANALYTICAL TECHNIQUES IN AERODYNAMIC HEATING PROBLEMS. Naval Ordnance Test Station, China Lake, Calif. NOTS TP 2677. 28 Apr 1961. 34p. (NAVWEPS rept. no. 7653) ASTIA AD-258 223.

Includes: TEMPERATURE CHANGES DURING HEATING OF AN HPAG 5.0-INCH MOTOR: CORRELATION OF EXPERIMENTAL DATA WITH ANALOG COMPUTATIONS, by C. H. Johnson: Temperature data on a 5.0-inch HPAG rocket motor served to guide the set up of an analog computer model. The study was prompted by observations that temperatures in heated Sidewinder 1C motors differed appreciably depending on whether the test point was at the top, side, or bottom of the motor. DETERMINATION OF WALL TEMPERATURE-TIME FUNCTIONS USING AN ANALOG COMPUTER, by William H. Smith: The use of an analog computer to obtain solutions of the outside surface temperature of aerodynamically heated bodies resulted in a large saving over hand solutions. WHEN IS A SKIN THERMALLY THIN, by Jerome R. Katz: A method for determining skin thickness is discussed for 1, 5, and 10% variations in temperature throughout the material.

36. Lange, R. H., et al.
SURVEY AND ANALYSIS OF HYPERSONIC AND RE-ENTRY VEHICLES. Lockheed Aircraft Corp., Marietta, Ga. Rept. on Research on Aerodynamic Flow Fields. Sep 1961. 113p. (ARL-62) (Contract AF 33(616)7237. Proj. 7064) ASTIA AD-269 238.

A survey and analysis was made of the aerothermodynamic problem areas in the flight spectrum of hypersonic glide and re-entry vehicles. This flight spectrum was defined by speeds between 5000 ft/sec and orbital speed and by altitudes between 100,000 and 400,000 feet. Major problem areas of flight within this spectrum were analyzed to determine the coverage of existing data and to recommend areas where further research is needed.

37. Lardner, Thomas J.
APPROXIMATE SOLUTIONS FOR MELTING AND ABLATION PROBLEMS. Polytechnic Inst. of Brooklyn. N. Y. PIBAL rept. no. 654. Jun 1962. 22p. (Contract Nonr-83923. Proj. NR 064-433) ASTIA AD-282 482.

A comparison of the exact solution with the approximate solutions obtained by the heat balance integral method and Biot's variational principle for the Stefan problem and the problem of ablation of a semi-infinite solid. The application of the variational principle and some of its shortcomings are discussed, in addition to an indication of the areas of disagreement between the exact and the approximate solutions.

38. Levy, Lionel L., Jr., and Elliott D. Katzen
COMPARISON OF TWO MANEUVERS FOR LONGITUDINAL RANGE CONTROL DURING ATMOSPHERE ENTRY. National Aeronautics and Space Administration, Washington, D. C. NASA Technical note no. D-1204. Jan 1962. 19p. (Also available from NASA, Wash. 25, D. C.) ASTIA AD-270 089.

Atmosphere entry trajectories were studied to determine the range for two types of maneuvers. For one type range was controlled principally by varying the point in the trajectory where the lift-drag ratio was reduced to maximum negative lift-drag ratio. For the other maneuver range was controlled principally by varying the value to which the lift-drag ratio was reduced. The influence on range of maximum deceleration limits and an error in lift-drag ratio were included; the convective and radiative heating to the stagnation point of the spacecraft were also studied. The analysis was made for a spacecraft with a maximum lift-drag ratio of 0.5 entering the earth's atmosphere at parabolic velocity. Results for both types of maneuvers indicate that the spacecraft aerodynamics can provide ranges up to global range.

39. Manos, William P. and Donald E. Taylor
THERMAL PROTECTION OF STRUCTURAL, PROPULSION, AND TEMPERATURE-SENSITIVE MATERIALS FOR HYPERSONIC AND SPACE FLIGHT. PART III. ANALYTICAL STUDIES OF PHENOMENA FOR THERMAL PROTECTION. Laboratories for Applied Sciences, U. of Chicago, Ill. Rept. for 1 Oct 1959 – 30 Nov 1960, on the Chemistry and Physics of Materials. Jul 1961. 167p. (WADD TR 59-366, pt. 3) (Contract AF 33(616)6006, Proj. 7360) ASTIA AD-267 510.

An analytical study of mass transfer cooling in turbulent boundary layers. For 0 pressure gradient, flat plate flow, the effectiveness of mass addition in reducing heat transfer was less in the turbulent boundary layers than in laminar boundary layers. The cooling phenomenon at axisymmetric stagnation points was studied by introducing air and He through a porous wall. Below certain critical injection rates, experimental heat transfer with air injection agreed with theoretical predictions. For coolant flow rates in excess of certain critical values, heat transfer rates increased and became erratic. The effect of upstream mass injection on downstream heat transfer shows downstream heat transfer increased from mass injection. The 1-magawatt air-stabilized arc was operated with a mixing chamber and transition piece, and characterization studies including temperature determinations and calorimetry were performed.

40. Mathias, Ronald F. and Walter S. Vikestad S
SIMULATED RE-ENTRY EFFECTS ON ABLATIVE NOSE CONE MODELS PREDAMAGED BY FRAGMENT IMPACT (U). Ballistic Research Labs., Aberdeen Proving Ground, Md. Memo. rept. no. 1382. Dec 1961. 73p. (Proj. 503-05-010) ASTIA AD-328 620. SECRET REPORT

Predamaged nose cone models were subjected to a simulated re-entry to investigate how the heat effects could be used for destruction of a missile. Cone materials utilized were CT 301 and CT 304 on cast Al substructures. Damage consisted of drilled holes and holes caused by fragment impact. The largest hole was about 5.0 sq in. in area and the smallest was a 1/4 in. in diameter drilled half way into the heatshield material. The tests were conducted with 15-in. base models in the 164 HT rocket burner at the Marshall Space Flight Center. Destruction of the model resulted under some of the test conditions. (Unclassified abstract)

41. Myer, Hans G.
RADIATION FROM SHOCK-HEATED AIR. PART I. EQUILIBRIUM RADIATION. Space Technology Labs., Inc., Los Angeles, Calif. Rept. no. 6130-0001-NU-P01. Oct 1961. 33p. (Contract AF 04(694)1) (BSD TN 61-21) ASTIA AD-269 741.

Presentation of a computational procedure giving equilibrium radiative heat transfer rates to the surface of a shock engulfed vehicle. The local transfer rates are obtained in terms of the local temperature and density at the outer edge of the boundary layer and an effective thermal layer. The computed radiative transfer rates around a typical entry vehicle are presented. A computational procedure for the non-equilibrium radiation is presented in Part II.

42. Myer, Hans G. S
RADIATION FROM SHOCK-HEATED AIR.
PART II. NON-EQUILIBRIUM RADIATION (U).
Space Technology Labs., Inc., Los Angeles, Calif.
Rept. no. 6130-0001-NS-P02. Dec 1961. 20p.
(Contract AF 04(694)1) (BSD TN 61-21)
ASTIA AD-328 727. SECRET REPORT

A computational procedure giving non-equilibrium radiative heat transfer rates to the nose region of a shock-engulfed vehicle is presented. The local transfer rates are obtained as a function of the altitude and the velocity. The computed radiative transfer rates around the nose region of a typical entry vehicle are presented. (Unclassified abstract)

43. Myers, James R. and Blaine W. Roberts S
AERODYNAMIC HEATING INVESTIGATION
OF A SCALE MODEL OF THE POLARIS A3
EXIT CONFIGURATION AT MACH 8 (U).
Arnold Engineering Development Center,
Arnold Air Force Station, Tenn. Rept. no.
AEDC TDR 62-94. May 1962. 23p. (Contract
AF 40(600)800, Proj. 9015) ASTIA AD-329 292L.
SECRET REPORT

44. Nesbitt, M. H. and L. R. Carpenter
COMMENTS ON THE USE OF COMBUSTION GASES AS AN AERODYNAMIC TEST MEDIUM.
Arnold Engineering Development Center, Arnold Air Force Station, Tenn. Rept. no. AEDC TDR 62-38. May 1962. 49p. (Contract AF 40(600)800) ASTIA AD-275 194.

Theoretical and experimental studies of pressure and heat transfer distributions for simple bodies (at a Mach number of about 6.5 and a stagnation temperature of about 3000 R) were made using both air and combustion gas as the testing media. Experimental differences between test media indicate that the use of combustion gases in the regime investigated does not appear promising. Gas-liquid phase changes caused test complication, and the attendant test results were difficult to interpret or adjust to actual flight conditions.

45. Nickell, E. H. and W. E. Jacobsen
FACTOR OF SAFETY CONSIDERATIONS FOR AERODYNAMICALLY HEATED STRUCTURES SUBJECTED TO HIGH CYCLIC STRESSES.
Lockheed Aircraft Corp., Sunnyvale, Calif. Final rept. 1 Mar–31 Aug 1961. Oct 1961. 121p. Rept. no. LMSC 2-04-61-1 (ASD TR 61-508) (Contract AF 33(616)8000, Proj. 1367) ASTIA AD-266 556.

Discussion of a parametric study made from published low-cycle fatigue data showing the various effects on cycles-to-failure. Included are uniaxial and biaxial experimental results. True total strain range, ratio of minimum-to-maximum strain, and effects of geometry are the predominate parameters affecting fatigue life for mechanical cycling at room and elevated temperatures. Structural life was investigated in terms of the parameters for mechanical cyclic loading as well as for cyclic thermal straining. In the former case, expressions relating the parameters to structural life were found. However, in the latter case, no reliable expression between these parameters and structural life was found. A specific expression for conservatively predicting structural life or endurance is developed and applies to all materials, ratios of minimum-to-maximum strains, temperatures, and states of stress. Also considered were single-cycle failures resulting from thermal shock.

46. Pellini, W. S.
ANALYSIS OF THE THERMOSTRUCTURAL REQUIREMENTS FOR THE ATMOSPHERIC RE-ENTRY OF SATELLITES AND SPACE VEHICLES. Naval Research Lab., Washington, D. C. NRL Rept. 5655. 15 Aug 1961. 33p. ASTIA AD-264 753.

The thermostructural requirements of re-entry vehicles are determined by the kinetic energy of the vehicle on penetration of the atmosphere and by the program of the dissipation of this energy by conversion to heat, which is generated by the aerodynamic braking effects of the atmosphere. The vehicle velocity and entry angle may be classed as approach variables and the aerodynamic characteristics of the body as vehicle variables. These variables are discussed, with particular emphasis on the wide range of energy conversion programs which are made available by choice of the vehicle design. The possible types of re-entry vehicles are analyzed by a description of the aerodynamic characteristics of the various principal types. The aerodynamic features of re-entry vehicles may be classified into the two broad subdivisions of lift and drag flight. Lift flight vehicles are represented primarily by the glide aircraft and lifting capsule families, and drag flight vehicles by drag capsules, satellite bodies, and nose cones. The primary distinction is between bodies that rely on aerodynamic lift, with the associated drag for gradual deceleration from orbital to subsonic velocity, and bodies that undergo a shocklike deceleration to terminal fall velocity.

47. Petersen. T. L. C
(UNVERIFIED TITLE). Space Technology Labs.. Inc.. Los Angeles. Calif. Rept no. STL/TN-59-0000-09340. 31 Dec 1959. 42p. CONFIDENTIAL REPORT

48. Pfeffer. I. S
BAMBI PHASE II TECHNICAL INVESTIGATIONS. SINGLE INTERCEPTOR SATELLITE. VOLUME III (U). Space Technology Labs.. Inc.. Redondo Beach. Calif. Quarterly technical summary rept. no. 2. vol. 3. 2 Jan–2 Apr 1962. Rept. no. 8637-6031-NQ-002. 20 Apr 1962. 1v. (SSD TDR 62-25. vol. 3) (Contract AF 04(695)10) ASTIA AD-329 298. SECRET REPORT

49. Porter, J. C
AERODYNAMIC HEATING OF THE STRUCTURE OF THE BLUE STREAK BALLISTIC MISSILE INCLUDING THE THERMODYNAMICS OF THE PROPELLANT TANKS (U). Royal Aircraft Establishment (Gt. Brit.) Technical note no. GW 598. Nov 1961. 18p. ASTIA AD-328 279. CONFIDENTIAL-MHA REPORT

50. Prevention of Deterioration Center, National Research Council, Washington, D. C. ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. VOLUME I. NUMBER 5. May 1961. 1v. 79 refs. ASTIA AD-256 494.

51. Prevention of Deterioration Center, National Research Council, Washington, D. C. ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. SECTION B. VOLUME 2B, NUMBER 1. Jan 1962. 17p. ASTIA AD-283 811.

SECTION A: Information on environmental factors, their effects on materials and equipment, materials resistance, corrective or preventive measures, and test methods. (Section A is the successor to the Prevention of Deterioration Abstracts, a service covering the identical area of interest since 1946.) SECTION B: Similar in treatment to Section A but with information dealing predominately with physical and engineering considerations – mechanical shock and vibration, thermal extremes, vacuum, magnetic and gravitational fields, natural radiations found in space, dissociated and ionized gases, meteoroids and meteoric dust. (Section B is a continuation of Environmental Effects on Materials and Equipment, Volume I which commenced in January 1961.)

52. Prevention of Deterioration Center, National Research Council, Washington, D. C. ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. SECTION B. VOLUME 2B, NUMBER 2. Feb 1962. 17p. ASTIA AD-283 812.

53. Prevention of Deterioration Center, National Research Council, Washington, D. C. ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. SECTION B. VOLUME 2B, NUMBER 3. Mar 1962. 18p. ASTIA AD-283 813.

54. Prevention of Deterioration Center, National Research Council, Washington, D. C. ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. SECTION B. VOLUME 2B. NUMBER 4. Apr 1962. 18p. ASTIA AD-283 814.

55. Prevention of Deterioration Center, National Research Council, Washington, D. C. ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. SECTION B. VOLUME 2B. NUMBER 5. May 1962. 17p. ASTIA AD-283 815.

56. Prevention of Deterioration Center. National Research Council. Washington. D. C.
ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. SECTION B. VOLUME 2B. NUMBER 6. Jun 1962. 18p.
ASTIA AD-283 816.

57. Prevention of Deterioration Center. National Research Council. Washington. D. C.
ENVIRONMENTAL EFFECTS ON MATERIALS AND EQUIPMENT. ABSTRACTS. SECTION B. VOLUME 2B. NUMBER 7. Jul 1962. 19p.
ASTIA AD-283 817.

58. Readshaw. R.
Predicting temperature rises due to aerodynamic heating. AIRCRAFT ENGINEERING 33(383):8–11. Jan 1961.

Presentation of analog method (using trajectory data) of calculating temperature distribution throughout missile radome: (a) solution of heat conduction equation in radome medium; (b) solution of boundary condition at surface. Where medium is heated by forced convection. the method is applicable to other problems.

59. Research and Advanced Development Div., S
AVCO Corp., Wilmington. Mass.
ADVANCED RE-ENTRY VEHICLE PROGRAM (TASK VII) (U). Progress rept. no. 6 (Final). 1 July–31 Dec 1961. 23 Feb 1962. 38p.
Technical memo. no. RAD-TM-62-12. (Contract AF 04(647)305. Proj. WS107A-2) ASTIA AD-328 218.
SECRET REPORT

60. Rose, P. H. and E. Offenhartz
ABLATION MEASUREMENTS IN TURBULENT FLOW. AVCO Research Lab., Everett, Mass. Aug 1959. 30p. Research rept. no. 114. (AFBMD TR 60-25) (Contract AF 04(647)278) ASTIA AD-270 620.

Discussion of turbulent pipe flow experiments under conditions similar to the peak heating conditions of high performance ballistic missiles (approximately 20 percent lower enthalpy and one-half the stagnation pressure). Performance under these conditions of several typical ablation materials was investigated. It was possible to determine the effective heat of ablation for each of these materials and to experimentally demonstrate the difference between the ablative process in laminar and turbulent flow. Teflon experiments are discussed in detail to demonstrate the validity and power of this technique.

61. Rosner, Daniel E.
Surface temperatures of high speed, radiation cooled bodies in dissociating atmospheres. ARS. JOURNAL 31:1013–1015, 1961.

A brief examination of radiation cooled surface temperatures leads to the conclusion that, under certain circumstances, the operating surface temperatures in an initially undissociated environment are capable of exceeding those in an inert environment at the same stagnation enthalpy if, and only if, the average Lewis-Semenov number Le_f is greater than unity.

62. Roupe, George and Edward H. Miller
THE EFFECT OF VARYING REENTRY ANGLE AND REENTRY VELOCITY ON REENTRY HEATING. Air Force Special Weapons Center, Kirtland Air Force Base, N. Mex. Oct 1961. 275p. Rept. no. AFSWC TR 61–83. (Proj. no. 1831) ASTIA AD-270 566.

Examination of the effect of variance of reentry angle and velocity on the reentry heating experienced by a decaying earth satellite. Report includes quantitative results of the effect of a reentry angle variance between -0 and -60 degrees and a reentry velocity between 14,000 and 26,000 feet per second. Although the heat transfer analysis is approximate, the reentry trajectories used are believed to be quite accurate. Good correlation with other analytical work was observed. However, the most important observations are the general trends occurring as a result of reentry angle and velocity variation.

63. Ruger, Charles J.
APPROXIMATE SOLUTIONS FOR AERODYNAMIC HEATING OF REENTRY VEHICLES. Polytechnic Inst. of Brooklyn, N. Y. PIBAL rept. no. 729 Nov 1961. 18p. (Contract AF 49(638)445, Proj. 9781) (AFOSR-1761) ASTIA AD-268 826.

A consideration of aerodynamic heating of space vehicles during reentry with constant aerodynamic coefficients. General relations for the conditions at the maximum heating rate, and for the total heat input at the stagnation point from entry to any point in the trajectory, are developed. The relations are not subject to the restrictions of skip or exit trajectories with entry velocity greater than the circular speed. The relation presented for the heat input has 2 parts. The first, which is the most significant part of the heat input, is of closed form. The second is left in terms of an integral and evaluated by Simpson's rule. Only a small number of steps is required in the numerical evaluation of this integral, thus making this solution much shorter than direct numerical integration. The numerical results calculated from this solution show good agreement with those from the direct numerical integration.

64. Schafer, Howard C.
AERODYNAMIC HEATING OF SIDEWINDER 1C SUSTAINER GRAINS. Naval Ordnance Test Station, China Lake, Calif. NOTS TP 2736. Oct 1961. 11p. (NAVWEPS Rept. no. 7762) ASTAIA AD-265 244.

Sidewinder 1C sustainer grains were subjected to a heating cycle as follows: 130 F soak temperature; in 5 minutes raise motor tube skin temperature to 250 F and hold for 12 minutes; then raise to 350 F in 2 minutes and hold for 3 minutes; then cool to 250 F in 1 minute. The heating cycle was the basis of a test series, with the heat provided by a hexagonal oven consisting of six radiant heating panels. Detailed effects on the sustainer grain are described after a successful test, which, in a series, ran through five of the heating cycles.

65. Schmidt, D. L.
ABLATIVE THERMAL PROTECTION FOR AEROSPACE VEHICLES. Directorate of Materials and Processes. Aeronautical Systems Div., Wright-Patterson Air Force Base, Ohio. Rept. for Jan 1961 on Nonmetallic and Composite Materials. WADD TN 61-48. Nov 1961. 29p. (Proj. 7340) ASTIA AD-272 785.

Information on current and future aero-thermochemical flight regimes of aerospace vehicles is presented. Practical methods are discussed for alleviating extreme aerodynamic heating, with emphasis on ablative cooling and materials. Plastics are shown to possess the greatest inherent capability among existing ablative materials. New environments encountered in the future will place more critical demands upon ablative materials. These environmental trends and associated materials requirements are given in detail.

66. Schurr, G. G.
STUDY OF SOFT RECOVERY FROM TWO-STAGE VEHICLES. Space Recovery Systems, Inc., El Segundo, Calif. Jan 1962. 78p. (AFOSR/DRA 62-2) (Contract AF 29(600)2925) ASTIA AD-272 857.

Possible recovery methods for vertically reentering payloads released from two-stage boosters are investigated and discussed. Reentry trajectories including deceleration and heating rates were calculated for a series of reentry velocities and ballistic parameters. The influence of drag variation during reentry on peak deceleration and heating rates is investigated. A recovery method using a variable area drag brake (flexibrake), a parachute system and aerial snatch by helicopter was selected as the most suitable system for recovery of a payload released from a booster consisting of an XM-33 rocket as first stage and an ABLX 244 rocket as second stage. The flexibrake will limit the maximum deceleration to 15 G and the maximum deceleration onset rates to 300 G/sec. Attitude stabilization of the payload during the entire flight is maintained by a hydrogen peroxide attitude control system. Preliminary weights and volumes for the payload and recovery vehicle were estimated.

67. Schwartz, H. S.
CONFERENCE ON BEHAVIOR OF PLASTICS IN ADVANCED FLIGHT VEHICLE ENVIRONMENTS. Nonmetallic Materials Labs., Wright Air Development Div., Wright-Patterson Air Force Base, Ohio. Rept. on Non-Metallic and Composite Materials. WADD TR 60-101. Sep 1960. 460p. (Proj. 7340) ASTIA AD-247 100L.

Contents:
Thermal parameters of re-entry ablative plastics
The effects of thermal environmental parameters on ablation characteristics
The effects of material parameters on ablation characteristics
Studies on plastics exposed to high mass flow thermal environments
A brief review of the ABMA ablation materials program
A study of the mechanism of ablation of reinforced plastics
The importance of char structures in the ablation performance of organic polymers
Thermal stability of high-temperature carbon-chain polymers
Use of TGA in studying thermal decomposition of polymers
A study of hypersonic ablation
The ablation of plastics during hypersonic re-entry
Part two: Chemical reaction rates from TGA data
The infrared emission spectra of plastics ablating in a low enthalpy air stream:
Measurements of surface temperatures and temperature profiles behind the surfaces
Plastics in rocket nozzle environments
Solid propellant rocket motor insulation
Structural and insulative characteristics of ablating plastics
Thermal diffusivity—its significance and a method for determination
Effects of rapid heating on mechanical properties of composites
Effects of ultraviolet and vacuum on properties of plastics
WADD high temperature polymer program

68. Smith, Warren K.
NOTES ON THE USE OF MATERIALS UNDER AERODYNAMIC HEATING CONDITIONS. Naval Ordnance Test Station, China Lake, Calif. NOTS rept. no. TP 2688. 21 Jul 1961. 58p. (NAVWEPS rept. no. 7660) ASTIA AD-265 921L.

69. Space Technology Labs., Inc., Redondo Beach, Calif. S
698B PHASE II TECHNICAL INVESTIGATIONS. SINGLE INTERCEPTOR SATELLITE, VOLUME III (U). Quarterly technical summary rept. no. 3. 2 Apr–2 Jul 1962. Rept. no. 8637-6079-KA-000. 20 Jul 1962. 1v. (Contract AF 04(695)10) ASTIA AD-331 157. SECRET REPORT.

70. Summers, L. J. C
AERODYNAMIC HEATING DATA (U). Martin Co., Denver, Colo. Rept. no. WDD-M-SR-57-68. Oct 1957. 1v. (Contract AF 04(645)56) CONFIDENTIAL REPORT.

71. Suzuki, Bob Hiro
THERMAL STRESS-STRAIN DISTRIBUTION IN A TRANSVERSELY ANISOTROPIC MATERIAL DURING TRANSIENT HEATING. Institute of Engineering Research, U. of Calif., Berkeley Technical rept. no. HE-150-196; Series 128, Issue 8. 30 Mar 1962. 109p. ASTIA AD-274 375.

The potential of pyrolytic graphite as a skin structure for re-entry vehicles led to an investigation of its thermal and mechanical behavior during transient heating and at elevated temperatures. The general 3-dimensional equations of thermoelasticity are developed for a material whose properties exhibit the same anisotropic behavior as those of pyrolytic graphite. The equations are solved exactly for 2-dimensional temperature distribution which closely approximates the temperatures measured experimentally in pyrolytic graphite plates. An oxyacetylene flame apparatus was used to subject 1/8- and 1/4-in.-thick pyrolytic graphite plates to transient heating. The temperature distribution through the thickness and along the length of the plates was measured. An experimental technique was developed for measuring transient strains up to a temperature of 1500 F using a Tuckerman optical strain gage. The technique was applied to measure the thermal strain variation in the heated pyrolytic graphite plates.

72. Sychev, V. V.
ROTATION OF RE-ENTRY NOSE CONE. Science and Tech. Section, Air Information Div., Washington, D. C. AID rept. no. 61-141. 10 Oct 1961. 3p. (Trans. from Prikladnaya Matematika I Mekhanika, 25:600–610, 1961.) ASTIA AD-265 374.

The possibility of rotating a re-entry nose cone in order to combat aerodynamic heating is discussed.

73. Tempelmeyer, K. E., M. N. Nesbitt, and J. E. Shepard
SIMULATION OF HIGH TEMPERATURE AIR FOR AERODYNAMIC AND HEAT TRANSFER TEST PURPOSES. Arnold Engineering Development Center, Arnold Air Force Station, Tenn. Rept. no. AEDC TDR 62-40. Mar 1962. 42p. (Contract AF 40(600)800, Proj. 8951) ASTIA AD-273 674.

A method to simulate a gaseous test medium for aerodynamic and heat transfer tests is proposed. The solution of a set of simultaneous equations is used to specify a gas mixture which has the same macroscopic thermal and transport properties as some other gas or mixture. Experimental tests to determine the effectiveness of this gas simulation theory are also described. The addition of small amounts of argon, helium, and oxygen to a hydrocarbon combustion gas resulted in a new gas mixture which produced the same heat transfer and friction coefficients as air heated to the same temperature. A combustion gas test medium alone, however, exhibited different heat transfer characteristics than air. It therefore appears possible to avoid the use of some impractical test medium for certain test purposes by replacing it with a more convenient mixture of gases.

74. Tracy, Philip T. S
THERMAL ENERGY AVALANCHE CONVERSION PROCESSES (U). Geophysics Corp. of America, Bedford, Mass. Quarterly technical note no. 3. 15 Sep 1961. 22p. GCA Technical rept. no. 61-40-A. (Contract AF 30(602)2380, Proj. 5561) (RADC TN 61-206) ASTIA AD-326 001
SECRET REPORT.

75. Treanor, Charles E. and Paul V. Marrone
THE EFFECT OF DISSOCIATION ON THE RATE OF VIBRATIONAL RELAXATION. Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Rept. no. QM-1626-A-4. Feb 1962. 13p. (Contract DA 30-069-ORD-3443) ASTIA AD-273 103.

A calculation of the rate of dissociation behind strong shock waves in N2 and O2 which uses a revised model for the coupling of vibration and dissociation is discussed. In previous calculations a model which coupled the rate of dissociation to the degree of vibrational excitation (CVD model) was used. The present model adds to the CVD model the fact that the rate of vibrational excitation is in part determined by the rate of dissociation. Since the average energy of molecules which are dissociated is greater than the average energy of the remaining molecules, this coupling results in a drain on the average vibrational energy. It is shown that this coupling reduces the strong overshoot in vibrational energy that was previously obtained, and decreases the rate of dissociation behind strong shocks.

76. Wacholder, B. V. and E. Fayer
STUDY OF INSTRUMENTATION AND TECHNIQUES FOR MONITORING VEHICLE AND EQUIPMENT ENVIRONMENTS AT HIGH ALTITUDE. VOLUME I. VEHICLES AND ENVIRONMENTS. Radio Corp. of America, Camden, N. J. Rept. on Crew and Vehicle Environmental Data Sensing and Instrumentation. WADC TN 59-307, vol. 1. 1961. 163p. (Contract AF 33(616)6407, Proj. 8223) ASTIA AD-266-288.

A description of typical aerospace vehicles and their trajectories is discussed. The operating environments of these vehicles, in the region of space between the earth and the moon, are also discussed. Vehicles studied include the boost-glide vehicle, nearearth orbiting vehicles, extreme elliptical orbiting vehicles traversing the Van Allen radiation belts, transfer vehicles, and lunar vehicles. Each vehicle studied typifies some environmental problem, such as re-entry conditions or radiation effects.

77. Wang, Kenneth and Lu Ting
AERODYNAMIC HEATING OF RE-ENTRY VEHICLE. Polytechnic Inst. of Brooklyn, N. Y. PIBAL rept. no. 607. 24 Jun 1960. 2p. (Contract AF 49(638)445, Proj. 9781) (AFOSR TN 60-670) ASTIA AD-256 991.

It was found that the maximum heating rate occurred at the point of the trajectory very near to the minimum elevation. The fact that the major portion of the heat input also took place in the same part of trajectory as the velocity was used to obtain the analytic expression for the total heat input. The numerical results for the total heat input checked as closely with the machine calculations.

78. White, J. Frederick
FLIGHT PERFORMANCE HANDBOOK FOR POWERED FLIGHT OPERATIONS. FLIGHT MECHANICS AND SPACE VEHICLE DESIGN, EMPIRICAL FORMULAE, ANALYTIC APPROXIMATIONS AND GRAPHICAL AIDS. Space Technology Labs., Inc., Redondo Beach, Calif. Mar 1962. (Subcontract to Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena, Contract NAS 7-100) ASTIA AD-274 687.

Contents: Vehicle performance estimation techniques (Mission requirements, Orbital missions 2–3, Lunar and interplanetary mission requirements, Vehicle performance); System considerations (Launch site limitations, Range safety, Loads and aerodynamic heating, Guidance and tracking, and performance margin concept); Generalized exchange ratio analysis (Analytical relationships); Vehicle sizing (Payload ratio; Stage mass ratio, Optimum sizing for minimum gross weight-payload weight ratio, and General optimum sizing); Lunar/planetary deboost, Equations for impulsive vacuum deboost, and Velocity requirements for a vertical descent lunar landing); Planetary entry (Vehicle design considerations for atmospheric entry, Atmospheres of the planets).

79. Wurster, Walter H.
STUDY OF INFRARED EMISSION FROM HYPERSONIC AIR FLOWS. Cornell Aeronautical Lab., Inc., Buffalo, N. Y. Semi-annual rept., Jan—Jun 1962. CAL rept. no. QM-1626-A-9. Jul 1962. 19p. (Contract DA 30-069-ORD-3443) ASTIA AD-278 187.

Contents: Shock tube radiation measurements; Radiation computer programs; Numerical solutions of flow field; Binary scaling of nonequilibrium air flows; Kinetic model for air; Measured Transition probability for the first-positive band system of nitrogen; Nitric oxide bands near 1 mu in shock-heated air; A method for calculating diatomic spectra using a digital computer; A correspondence between normal-shock and blunt-body flows; A similitude for nonequilibrium phenomena in hypersonic flight; Non-equilibrium scaling criterion for inviscid hypersonic airflows; and the effect of dissociation on the rate of vibrational relaxation.

80. Yoskikawa, Kenneth K. and Bradford H. Wick
RADIATIVE HEAT TRANSFER DURING ATMOSPHERIC ENTRY AT PARABOLIC VELOCITY. National Aeronautics and Space Administration, Washington, D. C. NASA Technical note no. D-1074. Nov 1961. 17p. ASTIA AD-266 834.

Stagnation point radiative heating rates for manned vehicles entering the earth's atmosphere at parabolic velocity are compared with corresponding laminar convective heating rates. The calculations were made for both nonlifting and lifting entry trajectories for vehicles of varying nose radius, weight-to-area ratio, and drag. It is concluded that radiative heating will be important for the entry conditions considered.

PERSONAL AUTHOR INDEX*

*Numbers refer to citations.

CORPORATE AUTHOR INDEX*

*Numbers refer to citations.

SUBJECT INDEX*

*Numbers refer to citations.